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Investigating the Use and Acceptance of Technologies by Professors in a Higher Education Institution

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ABSTRACT

This article analyses the use and acceptance of technologies by professors in the teaching and learning context in a higher education institution. In the empirical study, a questionnaire based on the technology acceptance model was applied. The results indicated that the most used technologies are Moodle, Facebook and YouTube and it was concluded that in general, those technologies are well accepted. Few statistically significant differences between respondents' gender, scientific areas or ages were found, revealing that the use of those technologies is already widespread in the studied institution. Results also showed that perceived usefulness and perceived ease of use are two important determinants of Moodle acceptance, and that the majority of respondents did not know the MOOC concept. This article is valuable for researchers in the area and for professors that want to implement the use technologies in the teaching and learning context.

KEYWORDS

Higher education, Learning Management Systems, MOOCs, Technology Acceptance Model, Web 2.0

INTRODUCTION

Many Higher Education Institutions (HEI) have been developing courses using a variety of technologies to deliver distance education programmes, with e-learning being the most popular form (Arkorful, & Abaidoo, 2015; Zimnas, Kleftouris, & Valkanos, 2009). E-learning refers to the use of technologies in order to provide learning solutions where the learning context can be accessed from the web (Zimnas et al., 2009). The technologies that usually support the Teaching and Learning (TL) process in Higher Education Institutions (HEI) can be classified in Learning Management Systems (LMS), Web 2.0 technologies, or Massive Open Online Courses (MOOCs) platforms.

The main objective of this work is to present the results of an empirical study about the use and acceptance of the TL technologies by professors in a Portuguese Higher Education Institution - University of Aveiro (UA).

This paper is organized in five sections. The second section presenting the theoretical background performs an overview of the main technologies used in HE: LMS, Web 2.0 technologies and MOOCs platforms, and reviews the main models of technologies' acceptance. The third section describes the material and methods used in this study. The fourth section presents the results and discussion. Finally, the last section presents the main conclusions of the study and recommendations for further research.

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THEORETICAL BACKGROUND

Technologies Used in Higher Education

Information and Communication Technologies (ICTs) support TL process and are frequently involved in data collection, information processing and knowledge creation activities (Costa, Alvelos, & Teixeira, 2015). Nowadays, Universities adapt TL methods using the ICTs for knowledge transmission.

Students own and use a diversity of technologies, but institutions and instructors have yet to seize opportunities to create more varied learning experiences outside the classroom (Epelboin, 2013).

ICTs in education context have been changing according to the evolution of technology. The society has embraced new forms of communication over time. A typical example is the evolution from the basic correspondence through postal service to the variety of tools in Web (Moore, Dickson-Deane, & Galyen, 2011), where e-mail plays an important role.

Next subsections address the concepts of LMS, Web 2.0, and MOOCs platforms as important representatives of technologies used in education, particularly, in HEIs.

Learning Management Systems

Learning Management Systems (LMS) are technological systems used to create online courses (Paulsen, 2003) and grew from a range of multimedia and internet developments in the 1990s (Coates, James, & Baldwin, 2005). They allow users to register, monitor and evaluate activities and to manage contents, as well as to exchange information among geographically dispersed users. In the educational context, LMS allow the use of various methods to impart information, and develop skills and competences (Ekúndayò & Tuluri, 2011).

LMS support distance education and complement the traditional way of teaching (Costa et al., 2015), through e-learning activities such as communication, collaboration and information/knowledge transfer (Al-Busaidi & Al-Shihi, 2012). By using these systems, students can access courses' contents in different formats (text, image, sound), as well as interact with teachers and/or colleagues, via, for example, message boards, forums, chats, video-conferences (Sanchez & Hueros, 2010). These platforms are closed to authorized users, are teacher-centred and do not rely a lot on students' contribution (Manca & Ranieri, 2016). The LMS can be commercial solutions as Blackboard, or open-source ones, such as Moodle.

The current LMS incorporate Web 2.0 technologies (Holme & Prieto-Rodriguez, 2018). These platforms strengthen traditional academic values of sharing and collaborative creation of knowledge by providing teachers and learners with platforms for collaboration, thus enabling teachers and learners to jointly develop educational content, supporting the exchange of material, and facilitating community building (Ornellas & Carril, 2014). The LMS platforms allow maintaining a repository of information, but also designing an active, participative and collaborative virtual teaching, since they allow communication between all the members of the platform (Garcia et al., 2015).

Web 2.0 Technologies

Web 2.0 is a second generation of Web applications, based on online services, collaboration, communication, and sharing, and reflects different ways of promoting interaction between people (Bennett, Bishop, Dalgarno, Waycott, & Kennedy, 2012). It emerged in October 2004, developed by O'Reilly and MediaLive International (O'Reilly, 2005) and supports social interaction, feedback, conversation and networking, being endowed with a flexibility that enables collaboration. This paradigm redefines the interaction between Internet and users, allowing the creation of virtual applications using data and functionality from a number of different sources (Costa, Teixeira, & Alvelos, 2014). The use of Web 2.0 technologies has significant potential to support and enhance in-class TL in HEI (Ajjan & Hartshorne, 2008; Jimoyiannis, Tsiotakis, Roussinos, & Siorenta, 2013). The Web 2.0 technologies are open to everyone and anybody can use them (Ornellas & Carril, 2014).

Some of the Web 2.0 technologies are Wikis, Blogs, Microblogs, Social Networks, Social Bookmarks, and Media Sharing (Video Sharing, Podcasting, Photo Sharing, and Slides Sharing). Wikis allow one person or more to build up a corpus of knowledge in a set of interlinked Webpages, using a process of creating, writing and editing pages (Grosseck, 2009; Kear, Woodthorpe, Robertson, & Hutchison, 2010). Blogs represent a Webpage with brief paragraphs of opinions, information in the form of text, images, video, audio, or links, called posts, arranged chronologically being the most recent the first (Grosseck, 2009; Halic, Lee, Paulus, & Spence, 2010). Microblogs are similar to Blogs, that allow to publish brief online texts limited to 140-200 characters (Ebner, Lienhardt, Rohs, & Meyer, 2010; Holotescu & Grosseck, 2009; Hsu & Ching, 2012). Social Networks support collaboration, knowledge sharing, interaction, and communication of users from different places with a common goal (Al-Samarraie & Saeed, 2018; Grosseck, 2009). Media Sharing allow to store, search, display and share media' files (Anderson, 2007), being the most common Video Sharing, Podcasting, Photo Sharing, and Slide Sharing.

Massive Open Online Courses

The Massive Open Online Courses (MOOCs) concept emerged in 2008 (Blackmon & Major, 2017) and has been adopted by many universities across the world (Coates et al., 2005; Hew, & Cheung, 2014). MOOCs can be defined as online courses that bring together people who are interested in learning about a specific subject. Their main goal is to change "the fixed dynamics of rigid university training models and the traditional organizational structures of universities" (Aguaded-Gomez, 2013, p. 7). These courses are based on learning networks (Kop et al., 2011), are guided by subjects' experts as learning facilitators (Kop, Fournier, & Mak, 2011; Liyanagunawardena, Adams, & Williams, 2013), are free of charge, and provide the students with flexibility, on a variety of themes (Daniel, Cano, & Cervera, 2015). MOOCs provide an opportunity for people to access free courses offered by top universities in the world and therefore attracted great attention and engagement from college teachers and students (Xu & Yang, 2015).

In 2011, there was a 'wave of offers' of MOOCs (Tschofen & Mackness, 2012). Some universities have been offering online educational programs and creating their own MOOCs' platforms. This technology is being used as a new online educational model (Jung & Lee, 2018; Sharma, Joshi, & Sharma, 2016) where participants are encouraged to freely share information between them by means of technologies as Social Networks (Baker, Bujak, & DeMillo, 2012).

The LMS platforms can also be used for a form of courses which are small MOOCs with less than 10,000 students enrolled (Al-Samarraie & Saeed, 2018; Epelboin, 2013), like Small Private Online Courses (SPOCs) (Liu, Cheng, Liu, & Sun, 2017).

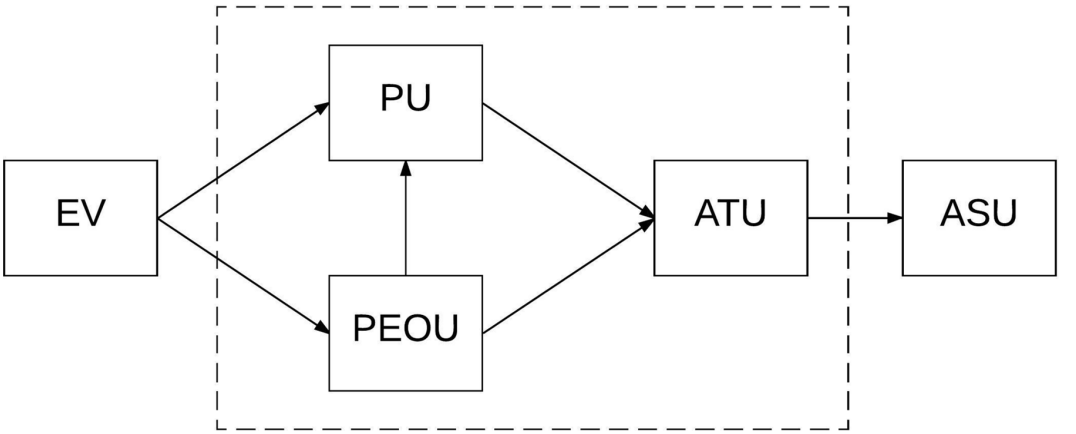
Acceptance of Technologies in Higher Education

The acceptance of technologies is usually evaluated through theoretical models such as the TAM - Technology Acceptance Model or UTAUT - Unified Theory of Acceptance and Use of Technology. The TAM is based on the Theory of Reasoned Action (TRA), in which the Theory of Planned Behaviour (TPB) is also based. UTAUT was developed based on TRA and TAM (Venkatesh et al., 2003).

The TAM, developed by Davis (1986), is the most widely used model of technology acceptance (Venkatesh et al., 2003). According to it (Figure 1), the Actual System Use (ASU) of the technology in evaluation, is determined by the Attitude Toward Using it (ATU), being this variable influenced by other two variables: Perceived Ease Of Use (PEOU) and Perceived Usefulness (PU). Those two variables can be influenced by External Variables (EV) (Davis, 1986).

Perceived Ease of Use (PEOU) is defined as the degree to which an individual believes that the use of a particular system is intuitive and does not require great effort (Davis, 1986; 1989). Perceived Usefulness (PU) is defined as the degree to which an individual believes that use of the system contributes to increase the performance of their work (Davis, 1986; 1989; Davis et al., 1989). Besides being influenced by external variables (EV), it is also influenced by PEOU, since technologies

Figure 1. TAM (Davis, 1986)



perceived as easier to use tend to be perceived as more useful. Attitude Toward Using (ATU) is defined as a positive or negative feeling of an individual towards the use of the system (Davis, 1986; 1989; Davis et al., 1989) and is influenced by PU and PEOU.

The application of TAM is an extension of the original model where EV are added according to the specific characteristics of the analysed technology (Oum & Han, 2011), such as features of technology, user characteristics, environments, user involvement, and structure of organization (Chen et al., 2012).

Concerning the Unified Theory of Acceptance and Use of Technology (UTAUT), developed by Venkatesh et al. (2003), and represented in Figure 2, it was based on other conceptual models of technologies' acceptance. This model consists of four constructs – Performance Expectancy, Effort Expectancy, Social Influence, and Facilitating Conditions – and also by four moderating variables – Gender, Age, Experience, and Voluntariness of Use (Venkatesh et al., 2003).

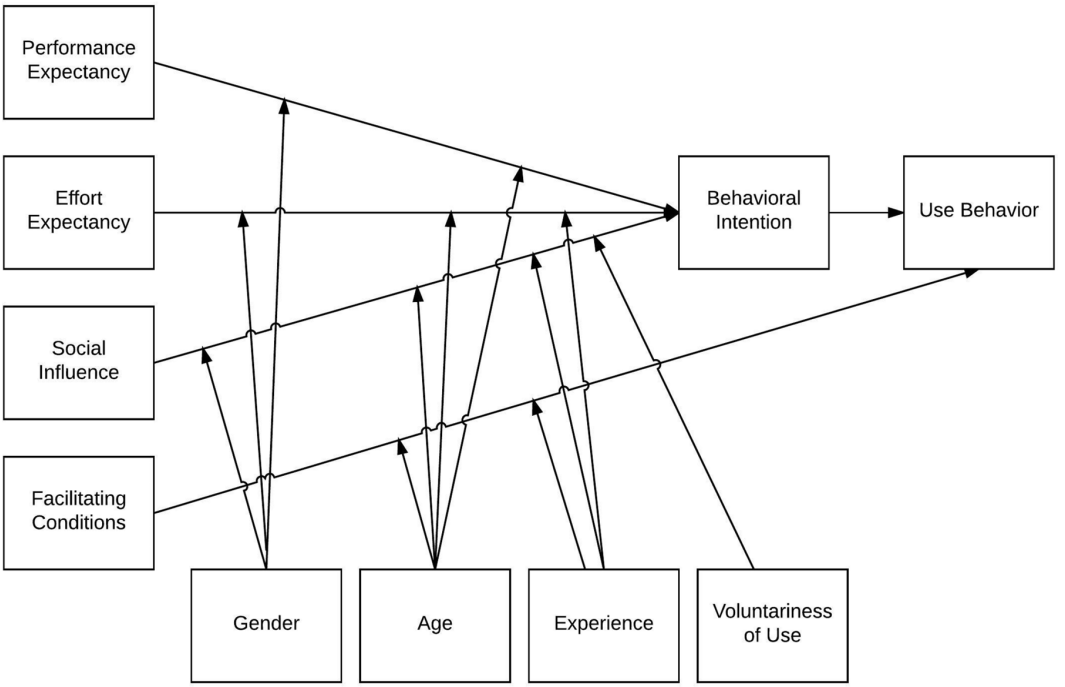
The Performance Expectancy is defined as "the degree to which an individual believes that using the system will help him or her to improve job performance" (Venkatesh et al., 2003, p.447). This construct evolved from other models' constructs, like, for example, the PU of TAM (Venkatesh et al., 2003). The Effort Expectancy is defined as "the degree of ease associated with the use of the system" (Venkatesh et al., 2003, p.450). This construct includes PEOU of the TAM (Venkatesh et al., 2003). The Social Influence is defined as "the degree to which an individual perceives how important it is for other people to use the system" (Venkatesh et al., 2003, p.451). The Facilitating Conditions are defined as "the degree to which an individual believes that an organizational and technical infrastructure exist to support the system" (Venkatesh et al., 2003, p.453). The first three constructs (Performance Expectancy, Effort Expectancy, and Social Influence) influence the Behavioural Intention and the last (Facilitating Conditions) influences the Use Behaviour.

In this study, the variables ATU, PEOU and PU of TAM were used, as well as Social Influence (SI) of UTAUT with External Variables.

MATERIAL AND METHODS

This study, carried out at the University of Aveiro (UA), aimed to analyse the use and acceptance of technologies used by professors in the TL context, being its main objectives: (i) to characterize the usage and the acceptance of the technologies used; (ii) to compare the acceptance of the technologies between some groups of professors; (iii) to use the TAM to better characterize the acceptance, by professors, of the most used technologies; and (iv) to explore the usage of MOOCs.

Figure 2. UTAUT model (Venkatesh et al., 2003)



The UA has an integrated structure that allows the articulation and harmonization of teaching and research environments and offers a wide range of degree programs in several areas of knowledge. Consequently, it has a multidisciplinary and innovative nature, offering 184 undergraduate and graduate courses, 14,280 students, and 903 professors. The UA has 16 departments and four polytechnics schools, comprising the areas of Life Sciences and Health, Natural and Environmental Sciences, Exact Sciences and Engineering, and Social Sciences and Humanities (UA, 2018). In this institution, the quality issue has been placed as a priority that is reflected in the three areas of its mission: Education, Research and Cooperation. Considering the Education area, the UA offers a broad range of ICT that support its processes.

The data collection of this study was performed using a questionnaire designed based on the literature review and applied to all the professors of the UA (903) between March and May, 2016. There were obtained 97 answers from diverse scientific areas. The final questionnaire resulted from the application of a prior version to a pilot sample of 5 professors and is divided into the following three sections:

- Characterization of the participants;
- Characterization of the use and acceptance of some LMS and Web 2.0 technologies;
- Characterization of the use of MOOCs.

The technologies' acceptance was assessed using the TAM variables and a five-point Likert scale that measured the level of agreement of the respondent with each item (1- do not agree at all; 5- completely agree). There were 19 items for characterizing the acceptance of the technologies not provided by the UA: Facebook, Linkedln, YouTube, Flickr, Instagram, iTunes, MediaWiki, Blogger, Twitter, and one more (20 items) for characterizing the acceptance of technologies provided by the

UA: Moodle, Educast, and a Web 2.0 platform named *Sapo campus* that provides Video Sharing, Photo Sharing, Wikis and Blogs.

Table 1 presents the variables and the TAM items considered in the evaluation of the referred technologies' acceptance. The expression "TECHNOLOGY X" should be replaced by each of the technologies under evaluation.

The collected data were analysed using the IBM SPSS Statistics 23 software. First, a descriptive analysis was performed, in order to characterize the participants and the behaviour of each variable measured. Following, Mann-Whitney and Kruskal-Wallis tests were carried out in order to verify whether there were statistically significant differences between levels of agreement regarding each variable among groups of professors characterized by gender, research areas, and age group. Finally, multiple regressions were used to calculate the influences and the relationships among TAM variables.

Table 1. Items considered in the evaluation of the acceptance of the usage of the technologies

Variable	Item
Perceived Ease Of Use (PEOU)	PEOU1- Learning how to use TECHNOLOGY X is easy.
	PEOU2- It is often necessary to consult the support/help tutorials to use TECHNOLOGY X.
	PEOU3- The TECHNOLOGY X menus and features are easy to understand.
	PEOU4- I get confused when I use the resources/activities of TECHNOLOGY X.
	PEOU5- I often make mistakes when I use TECHNOLOGY X.
	PEOU6- It's easy to remember how to perform the tasks related to the creation/editing of resources/activities in TECHNOLOGY X.
	PEOU7- Overall, I find TECHNOLOGY X is easy to use.
Perceived Usefulness (PU)	PU1- Using TECHNOLOGY X allows me to better organize and track tasks related to the Teaching-Learning process.
	PU2- TECHNOLOGY X allows me to perform tasks without being dependent on schedules.
	PU3- Using TECHNOLOGY X allows me to save time.
	PU4- Using TECHNOLOGY X improves the outcome of the Teaching-Learning process.
	PU5- Overall, I find TECHNOLOGY X useful for the Teaching-Learning process.
Attitude Toward Using (ATU)	ATU1- I like using TECHNOLOGY X in Teaching-Learning context.
	ATU2- I recommend the use of TECHNOLOGY X to support the Teaching-Learning process.
	ATU3- Overall, I have a favourable attitude towards using TECHNOLOGY X in Teaching-Learning context.
Social Influence (SI)	SI1- I use TECHNOLOGY X because it is provided by the University of Aveiro.*
	SI2- I use TECHNOLOGY X because I was influenced by colleagues.
	SI3- I use TECHNOLOGY X because I was directly or indirectly influenced by students.
	SI4- The editing features/activities in TECHNOLOGY X allow me to communicate/collaborate with students.
	SI5- I consider that there is a tendency to develop more activities using TECHNOLOGY X in the future.

Legend: TECHNOLOGY X- Technology under evaluation (Facebook, LinkedIn, YouTube, Flickr, Instagram, iTunes, MediaWiki, Blogger, Twitter, Moodle, Educast, Video Sharing–***Sapo campus***, Photo Sharing–***Sapo campus***, Wiki–***Sapo campus***, Blog–***Sapo campus***); *- item used in the technologies provided by the UA.

RESULTS AND DISCUSSION

The results from the questionnaire are presented in the following five sub-sections: (i) characterisation of the participants; (ii) characterisation of the use and acceptance of technologies; (iii) comparison of the acceptance between some groups of professors; (iv) use of TAM for evaluating the acceptance of the more used technologies; and (v) characterisation of the use of MOOCs.

Characterization of the Participants

Participants were 62 females and 35 males and the average age of respondents was 44.5 years old (s = 8.42). The majority of the professors were from the university subsystem (76; 79.2%), from which 50 (52.1%) were Assistant Professors, as illustrated in Table 2.

Table 3 presents the distribution of the respondents by the research areas. It can be observed that the majority of them were from Social Sciences and Humanities (54; 55.7%) and Exact Sciences and Engineering (36; 37.1%).

Characterization of the use and Acceptance of Technologies

The most used platforms by the respondents were: Moodle (96), Facebook (40), and YouTube (32). This result is in line with the results reported in the literature (Campanella et al., 2008; Escobar-Rodriguez, Carvajal-Trujillo, & Monge-Lozano, 2014; Danyaro, Jaafar, De Lara, & Downe, 2010; Galan, Lawley, & Clements, 2015; Manca & Ranieri, 2016). Professors, when faced with the use of two or more platforms of the same technology, indicated which one they use more, in order to proceed with the questionnaire regarding only that one.

Table 2. Professional category of academics

Education subsystem	Professional category	n	%
University	Full Professor	6	6.3
	Associate Professor	14	14.6
	Assistant Professor	50	52.1
	Assistant	6	6.3
Polytechnic school	Coordinator Professor	3	3.1
	Adjunct Professor	14	14.6
	Other	3	3.1
Total		**96**	**100.0**

Table 3. Research areas of the academics

Research areas	n	%
Life and Health Sciences	4	4.1
Natural and Environmental Sciences	3	3.1
Exact Sciences and Engineering	36	37.1
Social Sciences and Humanities	54	55.7
Total	**97**	**100.0**

Table 4 presents, for each platform, the number of answers given in the section related to the acceptance of the technologies used.

Regarding technology acceptance, the technologies with more answers were Moodle (96), Facebook (36) and YouTube (29) and their acceptance was evaluated by the variables described in Table 1. Table 5 presents a descriptive analysis of the answers to the items related to the referred variables.

In general, academics expressed a positive attitude concerning the various items. Regarding the items PEOU2– "It is often necessary to consult the support/help tutorials to use TECHNOLOGY X", PEOU4– "I get confused when I use the resources/activities of TECHNOLOGY X", and PEOU 5– "I often make mistakes when I use the TECHNOLOGY X", it should be noticed that the questions were asked using the scale with an inverted order, when compared with the other items. As a consequence, these items present low levels of agreement.

The values computed for the variables PEOU, PU, ATU and SI corresponded to the average values of the respective items, calculated for each respondent. This procedure led to different sample sizes, as the missing values had a higher impact in the variables considered (PEOU, PU, ATU and SI) than in the respective items. The values of the scale of the items PEOU2, PEOU4 and PEOU5 were changed, converting the level 1of the scale to 5, the level 2 to 4, the level 4 to 2, and the level 5 to 1.

Regarding Moodle, the mean value of PEOU was 3.98 (s = 0.634), with the items PEOU1– "Learning how to use Moodle is easy", and PEOU7– "Overall, I find the Moodle is easy to use" having a higher level of agreement. This result is consistent with the studies of North-Samardzic and Jiang (2015) and Wingo, Ivankova, and Moss (2017), where the ease of use of the technology is the most important factor that influences intention to use Moodle. The PU variable has a mean value of 3.89 (s = 0.756), with the item PU3- "Using Moodle allows me to save time" having, on average, lower value than the other items. This result was partially aligned with the study from Islam and Azad (2015) which indicated professors considered that Moodle "add an extra load to their teaching tasks and reduce their autonomy and control in the classroom". The mean value of ATU was 4.01 (s = 0.843), with items ranging from 3.94 to 4.08. The mean value of SI was 2.88 (s = 0.659), having the items SI2– "I use Moodle because I was influenced by colleagues" and SI3– "I use Moodle because I was influenced directly or indirectly by the students", on average, lower values than the other items. It should be noticed that the item SI1– "I use Moodle because it is the LMS provided by the University of Aveiro" presented the highest average value (4.64) of all the items, probably

Table 4. Number of answers to technologies' acceptance

Technology	Platform	Number of answers
LMS	Moodle	96
	Educast	4
Social Networks	Facebook	36
	Linked In	8
Video Sharing	YouTube	29
Photo Sharing	Instagram	5
Podcasting	iTunes	6
Wikis	Wiki-*sapo campus*	3
	Mediawiki	5
Blogs	Blog-*sapo campus*	4
	Blogger	4
Microblogs	Twitter	7

Table 5. Descriptive statistics of the items on the of technologies' acceptance

	Moodle					Facebook					YouTube				
Item	**n**	**Mean**	**Med**	**Mod**	**SD**	**n**	**Mean**	**Med**	**Mod**	**SD**	**n**	**Mean**	**Med**	**Mod**	**SD**
PEOU1	96	4.00	4.00	4	0.781	35	4.43	5.00	5	0.739	29	4.07	4.00	4	0.704
PEOU2*	95	1.96	2.00	2	0.933	32	1.66	1.00	1	1.035	27	2.07	2.00	2	0.874
PEOU3	92	3.80	4.00	4	0.867	34	4.15	4.00	4	0.784	26	3.77	4.00	4	0.992
PEOU4*	95	2.00	2.00	2	0.911	34	1.79	1.50	1	1.008	26	1.73	2.00	2	0.667
PEOU5*	95	1.87	2.00	2	0.775	34	1.82	2.00	2	0.834	25	1.76	2.00	2	0.663
PEOU6	95	3.85	4.00	4	1.000	33	3.97	4.00	4	1.045	25	3.80	4.00	4	0.866
PEOU7	96	4.04	4.00	4	0.832	34	4.24	4.00	4	0.781	28	4.04	4.00	4	0.838
PEOU	**89**	**3.98**	**4.00**	**4.00**	**0.634**	**32**	**4.23**	**4.14**	**5.00**	**0.663**	**25**	**3.99**	**4.00**	**4.00**	**0.630**
PU1	95	3.77	4.00	4	0.994	33	2.61	2.00	2	1.298	25	3.28	3.00	4	1.137
PU2	93	4.19	4.00	4	0.900	33	3.27	3.00	4	1.281	24	3.33	3.50	4	1.129
PU3	93	3.69	4.00	4	1.073	33	2.85	3.00	2	1.228	25	3.24	3.00	4	1.268
PU4	96	3.74	4.00	4	1.018	34	3.29	3.00	3	0.938	27	3.70	4.00	4	1.103
PU5	96	4.11	4.00	4	0.844	35	3.20	3.00	4	0.964	27	3.78	4.00	4	0.934
PU	**92**	**3.89**	**4.00**	**4.00**	**0.756**	**33**	**3.04**	**3.00**	**3.20**	**0.944**	**23**	**3.39**	**3.40**	**3.00**	**0.949**
ATU1	96	4.00	4.00	4	0.846	36	2.92	3.00	3	1.079	26	3.81	4.00	4	1.021
ATU2	96	3.94	4.00	4	0.938	36	2.83	3.00	3	1.056	28	3.96	4.00	4	0.922
ATU3	96	4.08	4.00	4	0.854	36	3.06	3.00	3	0.955	27	4.00	4.00	4	0.877
ATU	**96**	**4.01**	**4.00**	**4.00**	**0.843**	**36**	**2.94**	**3.00**	**3.00**	**0.988**	**26**	**3.94**	**4.00**	**4.00**	**0.885**
SI1	96	4.64	5.00	5	0.651	---	---	---	---	---	---	---	---	---	---
SI2	86	2.05	2.00	1	1.283	35	2.71	3.00	4	1.363	24	2.58	3.00	3	1.248
SI3	87	1.74	1.00	1	1.051	36	2.64	3.00	1	1.397	26	2.65	2.50	2	1.263
SI4	96	4.04	4.00	4	0.905	36	3.56	3.00	3	0.843	25	3.04	3.00	3	1.136
SI5	95	3.76	4.00	4	0.964	33	3.70	4.00	4	1.045	26	3.85	4.00	4	1.008
SI	**86**	**2.88**	**2.88**	**2.75**	**0.659**	**32**	**3.16**	**3.25**	**3.25**	**0.570**	**21**	**2.98**	**3.00**	**3.00**	**0.782**

Legend: *- scale with an inverted order; N- number of respondents; Med- median; Mod- mode; SD- standard deviation.

reflecting that professors felt the importance of having a LMS available to support the TL process and used the one provided by the institution where they teach.

Concerning Facebook, the mean value of PEOU was 4.23 (s = 0.663), and the items PEOU1 and PEOU7 have had a higher level of agreement than the others. This result reveals that Facebook is relatively easy to use, as the study of Pinho and Soares (2011) point out. The mean value of the PU variable was 3.04 (s = 0.944), and the items of PU present average values from 2.61 to 3.29. The mean of ATU is 2.94 (s = 0.988) and its items present average values ranging from 2.86 to 3.06. According these findings, the perceived usefulness and ease of use can have impact on the intention to adopt Facebook (Rueda, Garcia, & Silva, 2017; Thongmak, 2014). The mean value of SI was 3.16 (s = 0.570) having the item SI5 a higher value than the other items.

Considering YouTube, the mean value of PEOU was 3.99 (s = 0.630) with the items PEOU1- "Learning how to use YouTube is easy" and PEOU7- "Overall, I find the YouTube is easy to use" showing a higher level of agreement. The items that belong to PU present average values from 3.24 to 3.78. The items on the variable ATU present average values of agreement ranging from 3.81 to 4.00. Regarding SI variable it can be stressed that the item SI5 presents an average value (3.85) higher than the other items.

It is interesting to note that, in what concerns the variable PEOU, the three technologies analysed had PEOU1 and PEOU7 as the items showing higher values, probably meaning that the ease of use is an important issue for the respondents that is present in all these technologies. Regarding SI items, it should be remarked that, while with Moodle the higher level of agreement refers to its use because it is the LMS provided by the UA, with Facebook and YouTube the tendency of using them in the future is the highest valued item. Comparing the main variables among the three technologies, the PEOU has a higher mean value in Facebook than in other technologies, suggesting that it is an easy-to-use technology. The PU has a higher mean value in Moodle than YouTube and Facebook, probably meaning that Moodle is more useful in the TL context. The ATU had a higher mean value in Moodle than in the other technologies, showing that professors have a favourable attitude in using this tool in the TL context. The SI showed a higher mean value for Facebook, confirming its greater social nature.

Comparison of the Acceptance of the More used Technologies Between Groups of Professors

In this section some comparisons of the acceptance of Moodle, Facebook and YouTube between groups of professors based on gender, age group and scientific area were performed. The age groups considered were [28, 39], [40, 49] and [50, 67] and the scientific areas considered were area A that grouped Life and Health Sciences, Natural and Environmental Sciences, and Exact Sciences and Engineering, and area B that was Social Sciences and Humanities. The statistical tests performed were Mann-Whitney for gender and scientific area and Kruskal-Wallis for age groups, and Table 6 presents the items for which the null hypothesis was rejected and, therefore, the differences among groups were statistically significant.

The comparison of the Moodle acceptance between gender, show statistically significant differences in items PEOU1, PEOU7, PU4, PU5, ATU1 and ATU3, where the females present, on average rank, higher values than males. These results are similar to those presented in the study of Padilla-Meléndez, Aguila-Obra, & Garrido-Moreno (2015), where females showed higher scores in the item "I like using Moodle".

Concerning the scientific area, there were statistically significant differences in the items ATU1, ATU2, ATU3 and SI2, where the professors belonging to area B presented, on average rank, higher values. This result is partially consistent with the study of Manca and Ranieri (2016) where the professors in "Humanities and Arts plus Social Sciences are more prone to use Social Media for their pedagogical affordances" (p. 229).

Regarding age groups, the only item for which there were statistically significant differences was SI5, where the group having 28 to 39 years old presents a higher average rank than the others, meaning that younger UA professors showed a tendency of developing more activities using Moodle in the future.

Relating to Facebook acceptance and the two gender groups, there were found statistically significant differences only in the variable ATU1 (p-value = 0.010), where the males presented, on average rank, higher values (18.90) than females (17.59), showing that men tended to use this technology in the TL context more than women.

Concerning YouTube, no statistical significant differences among the studied groups and for all the items were found.

The Application of TAM for Assessing the Most used Technologies' Acceptance

As the results presented in the previous section showed that there were some items for which there were statistical significant differences in the Moodle's acceptance concerning gender and scientific areas (6 in the case of gender and 4 in the case of scientific area), it was decided, in the case of this technology, to study the relationships presented in the TAM separately for the referred groups. Regarding Facebook and YouTube, the TAM was applied without considering groups of individuals, due to the inexistence of statistical significant differences among them. Therefore, there were analysed

Table 6. Results of Mann-Whitney and Kruskal-Wallis tests

	Group		Moodle		
			n	Mean Rank	*p*-value
PEOU1	Gender	F	62	53.64	0.007
		M	34	39.13	
PEOU7	Gender	F	62	52.48	0.043
		M	34	41,25	
PU4	Gender	F	62	52.69	0.038
		M	34	40.87	
PU5	Gender	F	62	52.74	0.029
		M	34	40.76	
ATU1	Gender	F	62	53.10	0.019
		M	34	40.12	
	Area	A	43	42.56	0.043
		B	53	53.32	
ATU2	Area	A	43	41.19	0.014
		B	53	54.43	
ATU3	Gender	F	62	52.60	0.035
		M	34	41.01	
	Area	A	43	41.49	0.016
		B	53	54.19	
SI2	Area	A	39	37.78	0.038
		B	47	48.24	
SI5	Age group	[28, 39]	23	58.33	0.020
		[40, 49]	39	49.53	
		[50, 67]	33	39.00	

Legend: F-Female; M-Male; A-Life and Health Sciences, Natural and Environmental Sciences, and Exact Sciences and Engineering; B-Social Sciences and Humanities.

the relationships among the constructs for six TAM models, namely, Moodle' TAM for female, Moodle' TAM for male, Moodle' TAM for area A, Moodle' TAM for area B, Facebook' TAM and YouTube' TAM.

The relationships were measured through Pearson correlations coefficients and regression models. The regression model was based in the original TAM, represented in Figure 1 (ASU was not object of this study), and thus consisting in the one simple regression and two multiple ones. The method used was the stepwise regression.

The expressions of the regressions performed can be represented as:

$$ATU = f(PEOU, PU),\ PU = g(PEOU, SI),\ \text{and}\ PEOU = h(SI)$$

where f, g and h represent linear functions of the variables between parenthesis.

The values of ATU, PU, PEOU, and SI were calculated by computing the mean values of the items that correspond to each of the variables.

Moodle Acceptance by Gender

Table 7 presents the Pearson correlations coefficients among the four TAM variables that resulted for Moodle by gender.

The results from Table 7 reveal that PU and ATU are strongly correlated (Pearson correlation coefficient between 0.7 and 0.9) for both genders. The correlation between PU and PEOU is only statistically significant in the case of the female group, while between ATU and PEOU the correlations are statistically significant for both groups, with intermediate values. Correlations between SI and PU and SI and ATU, although statistically significant for both genders, are stronger in the case of males (intermediate, versus weak correlations in the case of females).

The model that resulted from the correlations shown in Table 7 and from the regressions characterized next, are shown in Figure 3. Note that above each arrow is the value of the standardized coefficient (ß) of the correspondent regression, and next to each dependent variable the R-Square (RSq) value is presented.

In the Female regression model for Moodle (n = 53), the PU (β = 0.705) and PEOU (β = 0.262) were found to be significant predictors of the ATU, explaining 73.2% of the total variance. The PEOU (β = 0.415) and the SI (β = 0.289) were also found to be significant predictors of the PU, explaining 28.4% of the total variance (n = 48).

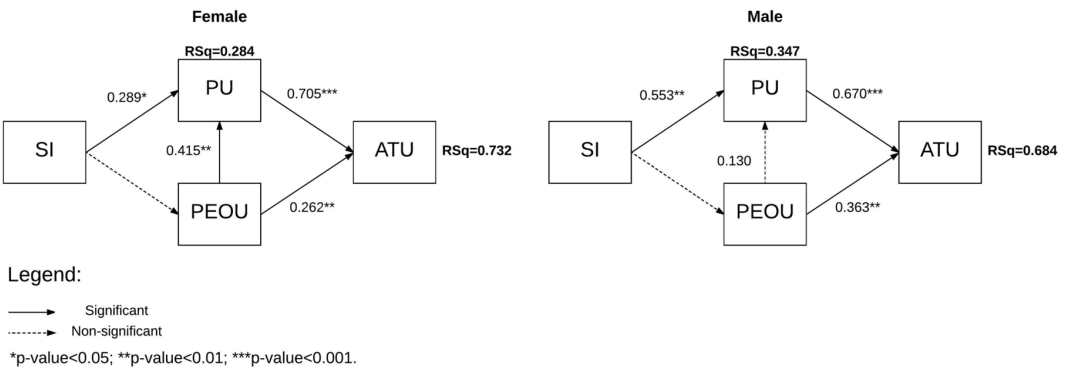
In the Male regression model for Moodle (n = 32), the PU (β = 0.670) and PEOU (β = 0.363) were found to be significant predictors of ATU, as in the female case, but explaining less of the total variance -68.4%. In what respects to PU, it was found, that unlike what happens with women, SI

Table 7. Pearson correlations coefficients among the four constructs of Moodle acceptance for females and for males

	Females				Males			
	PEOU	**PU**	**ATU**	**SI**	**PEOU**	**PU**	**ATU**	**SI**
PEOU	---	---	---	---	---	---	---	---
PU	0.451** (n = 53)	---	---	---	0.213 (n = 32)	---	---	---
ATU	0.474** (n = 57)	0.821** (n = 58)	---	---	0.506** (n = 32)	0.736** (n = 34)	---	---
SI	0.108 (n = 52)	0.342* (n = 53)	0.318* (n = 57)	---	0.166 (n = 28)	0.558** (n = 29)	0.589** (n = 29)	---

Legend: *Correlation is significant at the 0.05 level (2-tailed); **Correlation is significant at the 0.01 level (2-tailed).

Figure 3. Models obtained for Moodle in the UA, by gender



($\beta = 0.575$) was the only variable that was considered in the regression ($n = 28$), which explained 33.1% of the total variance.

In the models for both genders, the coefficients of the regressions PEOU = h(SI) are not statistically significant, thus indicating a lack of a linear relationship between those variables.

Moodle Acceptance by Scientific area

Table 8 presents the Pearson correlations coefficients among the four TAM variables of Moodle by scientific area, using the same notation as above: Area A- Life and Health Science, Natural and Environmental Science, and Exact Sciences and Engineering and Area B- Social Sciences and Humanities.

The results of correlations for Area A and for Area B are not very different. In fact, as happened with the previous analysis, the larger and most significant correlations are between the variables PU and ATU. The correlations between PU and PEOU are weak for both areas and between SI and PU are intermediate also for both areas. For the pairs 'ATU and PEOU' and 'SI and ATU', Area A shows higher correlations than Area B.

Regarding SI and PEOU, as happened with both genders, the correlations were not statistically significantly different. The model that results from the correlations shown in Table 8 and from the regressions characterized next, are shown in Figure 4.

In the Scientific Area A regression model for Moodle ($n = 37$), the PU ($\beta = 0.612$) and PEOU ($\beta = 0.384$) were found to be significant predictors of ATU, explaining 69.7% of the total variance. In the considered model ($n = 34$), PU is only explained by SI ($\beta = 0.489$), with a total variance explained of 23.9%.

Considering the Scientific Area B regression model for Moodle ($n = 48$), the PU ($\beta = 0.794$) and PEOU ($\beta = 0.177$) were significant predictors of ATU, explaining 75.4% of the total variance. The PEOU ($\beta = 0.316$) and SI ($\beta = 0.431$) were significant predictors of PU explaining 29.3% of the total variance ($n = 42$).

As with the models for both genders, the coefficients of the regressions PEOU = h(SI) are not statistically significant, thus indicating a lack of a linear relationship between those variables.

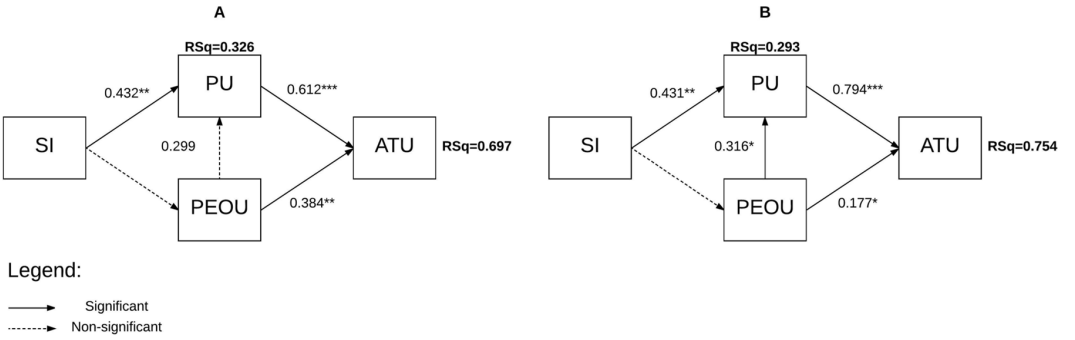
In the case of the Moodle, in all the four models studied (Female, Male, Area A, and Area B), the correlations between PU and ATU are strong, positive and significant. This result is in line with the study from Escobar-Rodriguez and Monge-Lazano (2012), which indicates that having the perception that Moodle increases the work performance, has a positive influence on the intention to use it. Concerning the PEOU, it has a positive correlation with ATU, again agreeing with the results of the study Escobar-Rodriguez and Monge-Lazano (2012). The correlation between PU and PEOU

Table 8. Pearson correlations coefficients among the four constructs of Moodle acceptance for the two groups of scientific areas

	Area A				**Area B**			
	PEOU	**PU**	**ATU**	**SI**	**PEOU**	**PU**	**ATU**	**SI**
PEOU	---	---	---	---	---	---	---	---
PU	0.373* (n = 37)	---	---	---	0.331* (n = 48)	---	---	---
ATU	0.559** (n = 40)	0.717** (n = 40)	---	---	0.397** (n = 49)	0.858** (n = 52)	---	---
SI	0.162 (n = 37)	0.459** (n = 36)	0.463** (N = 39)	---	0.074 (n = 43)	0.437** (n = 52)	0.356* (n = 46)	---

Legend: *Correlation is significant at the 0.05 level (2-tailed); **Correlation is significant at the 0.01 level (2-tailed).

Figure 4. Models obtained for Moodle in the UA, by scientific area



*p-value<0.05; **p-value<0.01; ***p-value<0.001.
A - Life and Health Science, Natural and Environmental Science, and Exact Sciences and Engineering; B - Social Sciences and Humanities;

is positive and statistically significant (except in the case of males). This result is only partially in line with the same study, where this relationship is not statistically significant.

Facebook and YouTube Acceptance

The results obtained for Facebook and YouTube are presented in this subsection, in the same way as were presented for Moodle but, as was already mentioned, without subdividing the original sample. Table 9 presents the Pearson correlations coefficients among the four TAM variables that resulted for Facebook and YouTube.

The results from Table 9 reveal that PU and ATU have strong statistically significant correlation values, both for Facebook and YouTube, which are very similar. Concerning YouTube, there is another statistically significant correlation value (moderate) and is between PU and PEOU. The low number of variables correlated for these technologies can be explained by the lower number of respondents to the questions related to them. The models that resulted from the correlations shown in Table 9 and from the regressions characterized next, are shown in Figure 5.

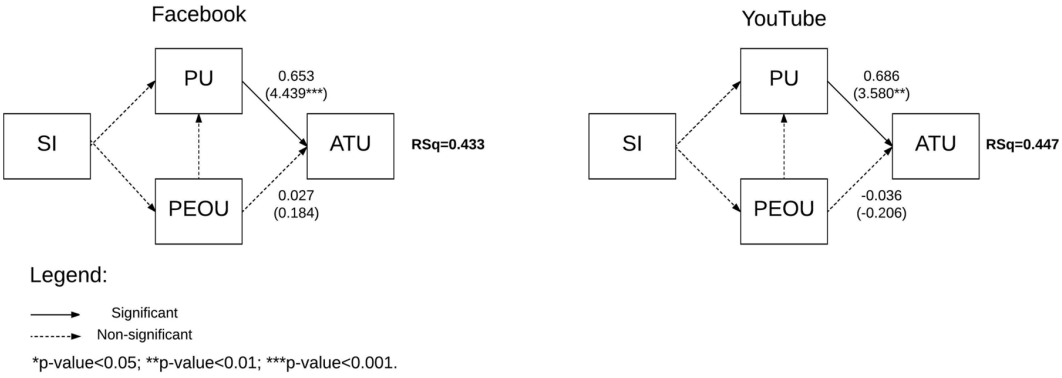
According to the models obtained for Facebook and YouTube, the PU was the only independent variable included in the regressions that explained ATU, that turned out to be simple linear ones. The regression for Facebook (n = 30) presents a $\beta_{PU\text{-}Facebook}$ of 0.658 and a total variance explained of 43.2% ($R^2_{Facebook}$) while the one for YouTube (n = 22) presents a $\beta_{PU\text{-}YouTube}$ of 0.668 and a total variance explained of 44.6% ($R^2_{YouTube}$).

Table 9. Pearson correlations coefficients among the four constructs of Facebook and YouTube acceptance

	Facebook				**YouTube**			
	PEOU	**PU**	**ATU**	**SI**	**PEOU**	**PU**	**ATU**	**SI**
PEOU	---	---	---	---	---	---	---	---
PU	0.172 (n = 30)	---	---	---	0.461* (n = 23)	---	---	---
ATU	0.153 (n = 32)	0.673** (n = 33)	---	---	0.316 (n = 23)	0.668** (n = 22)	---	---
SI	-0.211 (n = 28)	0.005 (n = 29)	-0.100 (n = 32)	---	-0.069 (n = 19)	0.415 (n = 19)	0.118 (n = 20)	---

Legend: *Correlation is significant at the 0.05 level (2-tailed); **Correlation is significant at the 0.01 level (2-tailed).

Figure 5. Models obtained for Facebook and YouTube in the UA



According to the multiple regressions just presented, it was verified that, in the TL context, the PEOU and PU constructs are important determinants of the acceptance of Moodle. This result is in accordance with Escobar-Rodriguez and Monge-Lazano (2012, p. 1086), that referring to the acceptance of Moodle, mention: "two important determinants to analyse what cause people to accept or reject information technology are perceived usefulness and perceived ease of use". Concerning Facebook and YouTube, the regression results only pointed out PU as a determinant of the technologies' acceptance. This could be explained by the fact that there are less respondents answering to those technologies, meaning that they are not so used and making more difficult to draw conclusions about their acceptance. On the other hand, the small sample dimension can be affecting the significance of the PEOU variable in the models.

Characterization of the use of MOOCs and MOOCs Platforms

The majority of the respondents (55; 56.7%) did not know the MOOC concept. From those who reported knowing the concept (42), 42.9% have already accessed MOOC platforms, 23.8% (10) attended to at least one MOOC, and 4.8% (2) collaborated on the development of at least one MOOC.

Table 10 relates to MOOC platforms and presents the number of respondents that reported they knew, consulted, attended, and used the referred platforms.

Coursera was the most known platform, being, also the one more consulted and attended.

It should be noticed that from those respondents that knew the concept 57.1% (24) would like to develop a MOOC, 31.0% (13) did not have an opinion about it. This fact should be considered because it can reveal that professors do not know the context and the concept sufficiently, in order to attend to and collaborate in the conception of MOOCs.

Table 10. Use of MOOC platforms

MOOC platform	Know	Consulted	Attended	Collaborated
Coursera	16	15	5	1
EdX	6	3	2	0
Others*	4	3	2	1

* Eco Project, Udacity, Moodle

CONCLUSIONS

In this study, the use and acceptance of technologies by professors in Higher Education Institution (HEI) were analysed. The technologies identified as most used in the Teaching and Learning (TL) process in HE were Moodle, Facebook and YouTube. The study on the technologies acceptance by the professors in the University of Aveiro was implemented through the application of a questionnaire based on the TAM.

The results of the questionnaire pointed out that in general Moodle, Facebook and YouTube were well accepted by the respondents.

When the acceptance' items applied to Facebook and YouTube were analysed, they do not show any statistical significant differences among groups of respondents based on gender, scientific area and age, probably revealing that the use of these technologies is already widespread in the TL context. Regarding Moodle, there were found statistical significant differences in some items, with females presenting, on average rank, higher values than males, and the Social Sciences and Humanities area presenting, on average rank, higher values than the other area.

Perceived usefulness presented a strong correlation with attitude toward using Moodle, while concerning Facebook and YouTube, the referred correlation was moderate.

According to the results of multiple regressions, perceived usefulness and perceived ease of use are two important determinants of the Moodle's acceptance, while regarding Facebook and YouTube, the only determinant of their acceptance is the perceived usefulness.

Results also showed that the majority of the professors did not know the concept of MOOCs, but the ones that know it, are aware of Coursera and EdX platforms, and would like to develop a MOOC in the future.

This study is limited to only one HEI. Future work should be done in order to expand the study to others HEIs, comparing the results and concluding about larger populations. The comparison of the acceptance between Moodle, Facebook and YouTube, which could not be performed due to the small number of respondents using the three technologies, can help to understand how they are being used and to explore the differences in order to contribute for a better use of each of them in the TL process.

As the results of this work provide insights on factors that contribute to the intention to adopt technologies in the TL context in Higher Education, the study is considered valuable not only for researchers in the area, as for professors that want to develop the implementation of technologies in their academic environment.

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